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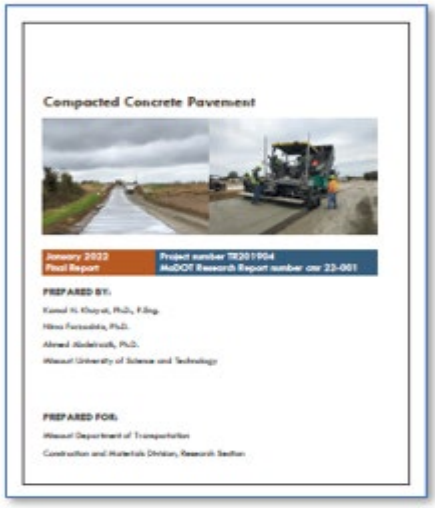
Research Summary

Compacted Concrete Pavement



To evaluate construction issues and characterize the performance of compacted concrete pavement (CCP), three CCP test cells were designed and constructed in Scott County, Missouri, as part of a larger construction project. The three CCP cells were prepared with and without structural synthetic macro fibers (cells 1, 2, and 3). The total pavement length was 42 ft for the three cells. Cells 1 and 2 were prepared with no fibers and had a length of 15 ft and 12 ft, respectively. Cell 3 was prepared with fibers and had a length of 15 ft. The width of the paved sections was fixed at 24 ft.

On October 24th, 2018, a test strip was paved in Scott County, Missouri. The Vebe consistency time and density of fresh compacted concrete were measured during the paving in compliance. MoDOT installed sensors to monitor strains due to variations in environmental conditions, dynamic load response, and joint openings. The sensors included a thermocouple tree, two joint opening block outs, vibrating wire strain gauges, and dynamic strain gauges.

Cast-in-field mixtures were prepared on the site at I-55 on October 25, 2018. The fiber-reinforced and non-fiber-reinforced mixtures were tested for flexural properties using 18 prismatic molds measuring 6”x6”x24” and for compression strength using 18 cylindrical molds measuring 6”x12”. Mixture 1 was used as the base mixture for the construction of Cells 1 and 2, while mixture 3 was prepared with 5 lb/yd^3 (pcy) of synthetic fibers to replicate Cell 3. The moisture content of the CCP was kept between 5% and 6%, and the water-to-cementitious material ratio (w/cm) was maintained between 0.31 and 0.38.

The compressive strength test was conducted in compliance with ASTM C39. All cylinders were capped using a high-strength sulphur capping compound according to ASTM C 617. Other tests, including surface electrical resistivity and freeze-thaw resistance of saw-cut samples, were conducted per AASHTO and ASTM guidelines.

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The compressive strength of a mixture containing 5 pcy fiber was found to be greater than that of samples made without fibers. The compressive strength of cast-in-field samples was found to be greater than that of saw-cut samples. The curing time increased the flexural strength. The freezing and thawing properties of mixtures prepared with and without fiber were comparable.

The curling and warping measurements were conducted on December 19th, 2018, September 27th, 2019, and September 16th, 2020. The measurements were conducted in the longitudinal, transverse, and diagonal directions. Over time, the curling and warping of pavement

sections increased. There was no discernible difference in deflection between the fiber-reinforced and unreinforced cells.

The falling weight deflectometer (FWD) was conducted on 16th of September 2020 by MoDOT. The test was used to measure the deformations at different locations from the loading plate. The analysis included the calculation of FWD deflection values as well as the load transfer efficiency (LTE) values derived from the readings of FWD at three different CCP slabs (Cell 1, Cell 2, and Cell 3). The FWD test results indicated that the deflection values in Cell 3 (CCP with fiber) were greater than those in the other two cells (without fibers).

A truck loading test was conducted by Missouri S&T, but results were not conclusive due to the high mortality rate of the embedded sensors.

According to environmental data analysis, longitudinal and transverse strains decreased during summer, reaching their lowest levels in early July. Following that, the strains began to increase as ambient temperature increased. The transverse strain decreased at a slower rate than the longitudinal strain. The results indicated that the use of fiber had no major effect on the deformations caused by environmental variations.

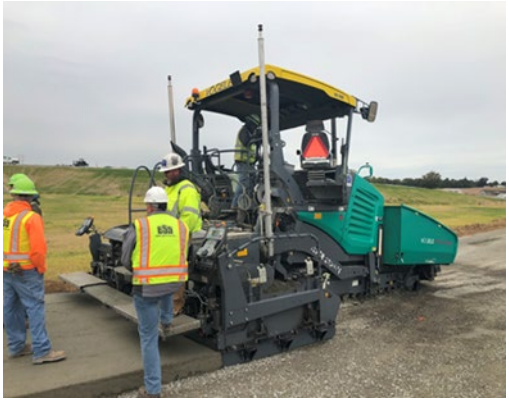

Figure 1: Paving process in Scott City, MO

Project Information

PROJECT NAME: TR201904—Compacted Concrete Pavement

PROJECT START/END DATE: September 2018-December 2021

PROJECT COST: $125,000

LEAD CONTRACTOR: Missouri University of Science and Technology

PRINCIPAL INVESTIGATOR: Kamal Khayat

REPORT NAME: Compacted Concrete Pavement

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Project Manager

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